

## SEMICONDUCTOR THIN FILM, METHOD FOR MANUFACTURING THE SAME, AND THIN FILM SOLAR CELL

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### Abstract of JP11026789

**PROBLEM TO BE SOLVED:** To raise light collection efficiency by forming such thin film as its main component is a solid solution represented in a specified equation. **SOLUTION:** A main component is  $\text{In}_x\text{X}_{1-x}\text{-MgX}$  solid solution of  $\text{In}_x\text{X}_{1-x}$  (X is S, Se, or Te, and x is value of 0-1) and MgX (X is S, Se, or Te). On a soda lime glass substrate kept at 200-300 deg.C, three evaporation sources (In, Mg, and Se) are vapor-deposited at the same time. Here, the evaporation rate of those evaporation sources is set as In; 5  $\text{\AA}/\text{s}$ , Mg; 5-15  $\text{\AA}/\text{s}$ , and Se; 20  $\text{\AA}/\text{s}$  to form a film of about 0.5  $\mu\text{m}$  in thickness. The wavelength of absorption end of  $(\text{In}_{1-x}\text{Mg}_x)_2\text{Se}_3$  solid solution thin film moves to the short wavelength side as x becomes large, to widen band gap. Therefor relating to a solar cell, as a band gap of a film becomes larger, the number of photon P incident on a p-n joint interface increases, thus a current value becomes larger, resulting in higher light collection efficiency.

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[0030] (Example 10) An Mo film with a thickness of 1.0  $\mu\text{m}$  as the electrode was formed on a glass substrate having a thickness of about 2.8 mm by the sputtering method. A Cu thin film and an In thin film were continuously laminated and formed on the Mo thin film by a vacuum deposition method so that the thicknesses of the Cu thin film and In thin film were respectively set to 0.2  $\mu\text{m}$  and 0.5  $\mu\text{m}$ . The laminated body was heated at 550°C in a sulfur atmosphere for 1 hour to form a  $\text{CuInSe}_2$  thin film having a thickness of about 2  $\mu\text{m}$ . Further, the In thin film and the Mg thin film were respectively and continuously laminated and formed on the  $\text{CuInSe}_2$  thin film by the vacuum deposition method. The laminated body was heated in the sulfur atmosphere to form an  $(\text{In}_{0.87}\text{Mg}_{0.17})_2\text{S}_3$  thin film having a thickness of about 0.1  $\mu\text{m}$ . A  $\text{ZnO:Al}$  film (obtained by doping Al of 2 to 3 wt% to ZnO) having a thickness of about 1.0  $\mu\text{m}$  was then formed on the  $(\text{In}_{0.87}\text{Mg}_{0.17})_2\text{S}_3$  thin film by the sputtering method. The energy conversion efficiency measured under the light irradiation of 0.1W/cm<sup>2</sup> due to a solar simulator of the solar cell obtained was 6.1%.